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AN EFFECTIVE WATERMARKING SCHEME FOR 3D MEDICAL IMAGES

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ABSTRACT

In this paper we have proposed method based on DFT and DWT transform in 3 dimensional domain. The method can be use to authenticate and secure the 3d medical image from different types of noise attacks, compression and geometrical attacks like median filter, translation, rotation and shear attacks. The method is useful for heftiness in opposition to violation of different filters and pruning. Additionally, in this watermarking finding, there is no loss of data at all i.e. lossless method. The whole process comprises ingraining and extraction dividing into small strips.

KEYWORDS: Lapel Watermarks; Heftiness; 3d Capacity Data; 3D-DWT; 3D-DFT

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INTRODUCTION

In current time multimedia data, medical data, video, data, picture data are very expeditiously increasing day by day.Moreover, in the medical field, hospitals and medical practices are going to be networked through the internet and share medical data all around the planet. So there may be some intrusion on these moving medical data for illegal benefits. Medical data must be protected from these illegal attacks otherwise it can harm the patient as well as the medical field in terms of finance and health. Watermarking pursuites have proved to be very useful in this regard. They can be used for authentication purposes, security purposes as per the need and sensitivity of the data. These pursuites can be broadly divided into 3 parts, "Robust watermarking, Fragile watermarking and Semi-fragile watermarking". Additionally, in case of medical field, thereis some sensitive information which cannot be tweaked in any ways as it will result in wreck of the image. Consequently, in this case, the image will be divided into two parts "Region of non interest (RONI) and Region of Interest (ROI)". Based on this impression, medical images can be divided into the following groups:

- In the first group, watermarking in done in the "RONI" part as specified earlier. Several methods in this group belong to the reversible and lossless methodalso.
- In this group, those methods come which needs only authentication of the image. It can be transitioned in both of the directions.
- Academic watermarking.

These 3 methods can be exploited to provoke a healthy watermark method which is further applied with "DWT and DFT".

WEBLET TRANSFORM (IN 3 DIMENSIONS)

Following Figurerepresents the Mallet Algorithm where U, V and W represents the 3 directions of the

image. The image will be digitized and then applying discrete weblet transform it will be divided into two parts, High frequency and Low frequency. Again, if High frequency contains nonuniformity, it will be further divided into two parts High frequency and Low frequency and the same thing will happen in the case of low frequency in case of nonuniformity. This procedure will be applied to all the three directions of the 3d capacity data of medical image.

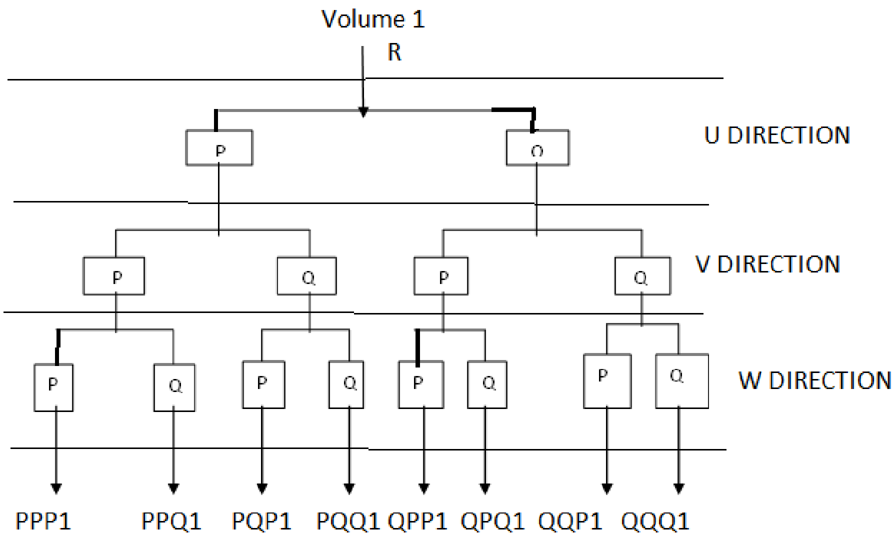

Figure 1: 3 Directional 2 Component Decomposition

FOURIER TRANSFORM (IN 3 DIMENSIONS)

It is a signal analysis theory of discrete Fourier transform (DFT). The U X V X W3d capacity data's three dimensions Fourier transform is defined by:

$$F(a, b, c) = \sum_{p=0}^{U-1}\sum_{q=o}^{V-1}\sum_{r=0}^{W-1} f(p,q,r).e^{-\frac{j2\pi a}{Vp}-\frac{j2\pi b}{Vq}-\frac{j2\pi c}{Vr}} \quad (1)$$

Where, p=0, 1,……, U-1;

q=0, 1,……, V-1; r= 0,1,……, W-1;

$f(p,q,r)$ Are the Voxel 3d capacity data R at the point (x, y, z) and F (c, d, e) be in contact to the three dimensional DFT coefficients.

METHOD BASED ON 3D WEB-LET AND 3D FOURIER

A Scheme to Retrieve the Item Vector of Medical 3D Capacity Data

We apply the "Discrete Weblet Transform" method to the initial 3d capacity data of the image as given in the above section and get the tuple PPP. Now we apply "Discrete Fourier Transform" on this output PPP with three Fourier coeficients.

So this method exploits 6 coeficients 3 for DWT and 3 for DFT. As shown in the following table the method works for different types of distortions specially geometric distortions like scaling, rotation or shear. Effect of these kinds of distortions result in lower coefficient modifications. For high frequency positive sign has been assigned while negative for the low frequency. Following Figurerepresents the result of different types of attacks like Gaussian Noise,

Compression, Cropping, Filtering etc.

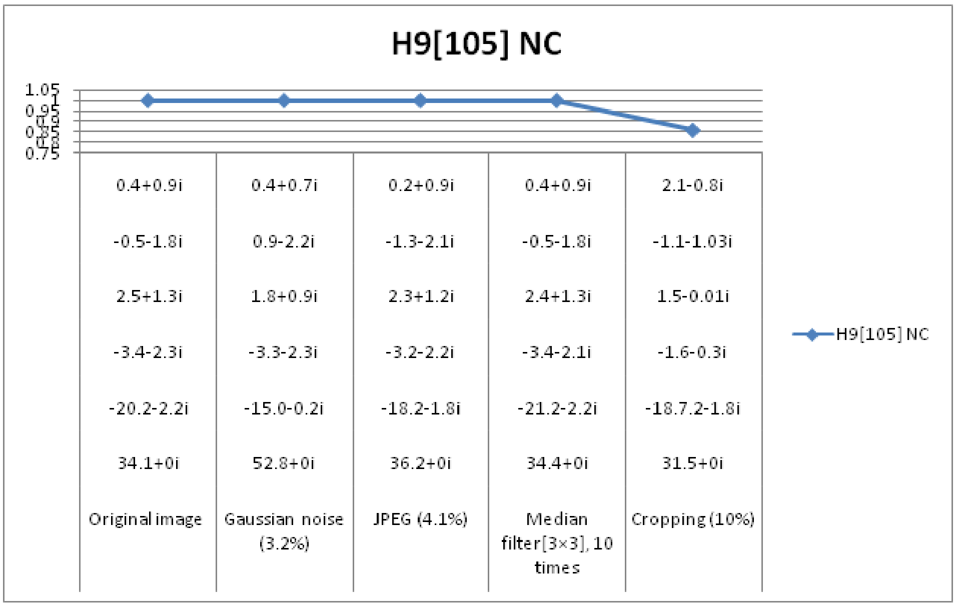

Figure 2: Effect on Frequency for Different Attacks

The ingraining and excerptin of collective watermarkswill be done are as below:

The Watermark will be provoked to the k group of binary ersatz contortorder. There arecollectivewatermarksingraining for

B^k (j). $B=\{b^k(j)|b(j)=0,1;\ 1\leq j\leq l,\ 1\leq k\leq n\}$, (2)

where l and n are the length and number of collective watermarks. The selected original 3d capacity data with 128×128×27 size. It is described as

$F = \{f_{(i,j,k)} | f_{(i,j,k)} \in E;\ \ 1\leq i\leq L,\ 1\leq j\leq M,\ 1\leq k\leq P\}$, (3)

where $f_{(i,j,k)}$designates the choral values of 3d capacity data R at the point(i,j,k).

INGRAINING COLLECTIVE WATERMARKS

Step1:

Input item needs to process through “three dimensional discrete wavelet transform (3D-DWT) & three dimensional discrete Fourier transform (3D-DFT)”. First of all we convert the image into 3 dimensional matrix to get the three coefficients to process these pursuits. After getting these 3 coefficients we apply DWT.Then,“three dimension Fourier transform (3D-DFT)” of the whole pursuit sub-band ma (i,j,k), PPP1 is calculated and the“three dimensions Fourier transform (3D-DFT)” coefficient matrix. The output after applying DFT is another 3 coefficient.Moreover, letthe frequency order O (j). It can be retrieved from “low frequency to high frequency”. The item vector R={r(j)|r(j)=0,1; 1≤j≤J} consist of the order of the low frequency “three dimension discrete wavelet transform (3D-DWT)-three dimension discrete Fourier transform coefficients”, where it can be value J tune the robustness and the ability of the embedded watermark.It is procedure describe as:

$$ma\_md\,(i, j, k) = DWT3(F(I,j,k))$$

$$FF(I, j, k) = DFT3(ca(I, j, k))$$

$$R(j)=sign(FF(I, j, k)) \tag{4}$$

Step2: In this step, the collectivewatermarks $B^k(j)$ and 3d capacity data R (j) will be employed to provoke the logical order, $var^k(j)$;

$$key^k(j)= B^k(j)\ ExOr\ (R\ (j)) \tag{5}$$

where R(j) designates the item vector of 3d capacity data, B^k (j) designates the collective watermark to be embedded, and is the exclusive-OR operator. The k-th var, var^k (j) is correlates to k-th watermarking, B^k (j).

This coefficient will be stored for the purpose of extraction of the watermark when needed. It can be computed $var^k(j)$ for the logical order moreover, It can be regarded secret var and registered to be the third part preserve the ownership of the original image.

Step 3: Extraction of 3d Capacity Data from the Collective Watermarks

Let the medical data is f(I,j,k) sent to the web after processing through "Discrete Weblet Transform and Discrete Fourier Transform".Let the variable by which it can be extracted at the receiver end is R'(j). Then 3D data can be extracted in the reverse manner as indicated in step 1. For all the slices the value is $R=\{r\ (j)\ |r\ (j) =0,\ 1;\ 1\leq j\leq J\}$. There are 6 coefficients generated, 3 for DWT and 3 for DFT

The Extraction process can be represented as follows:

$$ma\_md'(i, j, k)=DWT3(F'(I,J,K))$$

$$FF'(I, j, k)=DFT3(ca'(I, j, k))$$

$$R'(j)=sign(FF'(I, j, k)) \quad . \tag{6}$$

Here i,j,k are the dimension of the volume.

Step 4: Collective Watermarks $B^k(j)$ Extraction

$$B^k(j)=var^k(j)\ Ex\text{-}\ Or\ R'(j) \tag{7}$$

In the above equation $var^k(m)$ is the input variable stored at the time of embedding as indicated in step 1 while $Ex^k(m)$ is the extracted watermark. K in the superscript represent the kth slice of the volume data.All of the $B^k(j)$ obtained from the above equation will be put together one by one and we get the extracted volume data.

RESULT AND DISCUSSIONS

In our observation, it is used in absolute binary ersatz morph order100 groups. Every order is using 64 bits.In thisobservation of four stages group are arbitrarily selected group as 20^{th} group, 40^{th} group, 60 group and 80 group from 100 groups asthe embedded collective watermarks.It is 3d capacity data size of 128×128×27. There are original 3d capacity data represented by"F (I, j, k)". where $1\leq I,\ j\leq 128,\ 1\leq k\leq 27$. Corresponding "three dimension discrete wavelet transform and discrete Fourier transform" coefficient matrix is FF(I, j, k) considering the capacity embedded. For low

frequency we are considering the vector R(j).

There is order to measure the quantities; similarly the NC is use in this paper defined a

$$NC=\sum_i \sum_j [B(i,j).B'(i,j)]/\sum_i \sum_j [B(i,j)]^2 \quad (8)$$

Where B designate the "embedded watermarking" and B' designates "excerpting watermarking".

The amount of noise and the corresponding noises can be represented by the following figure.

In the Figure 3 below, we can see that for all of the noise types the curve of Noise parameter is linear, which indicates that there is no change in the content information of the core medical data. Likewise PSNR value is also approximately linear which indicates that there is no signal loss or gain at the output end of the image. Effect of different types of attacks is explained below:

- In case of Gaussian noise our method has given very good result. All the watermarks in the image were unchanged upto Gaussian noise of 5%.
- Compression upto 4% did no change in the image watermark.
- For median filter attack 10 times the quality degradation was recorded only 3% down.

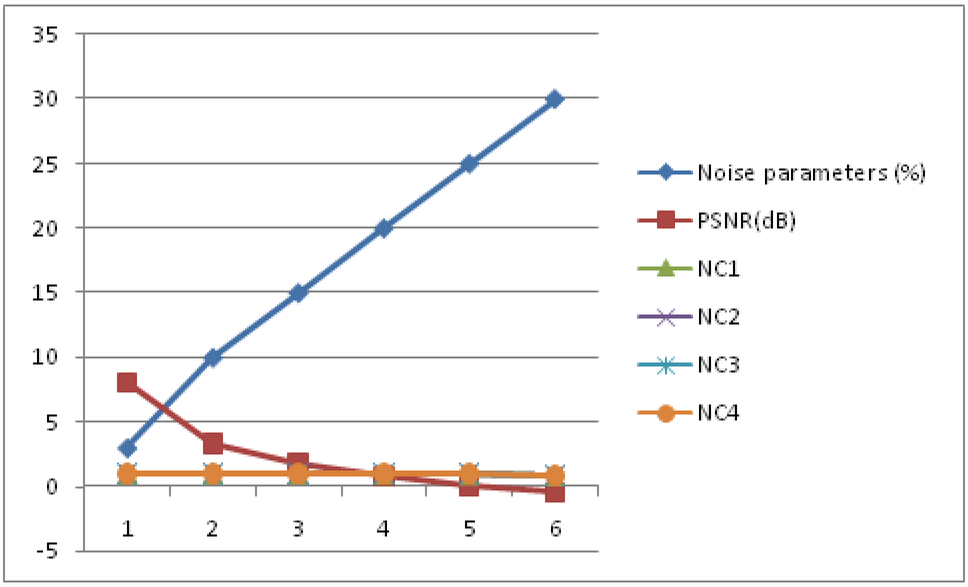

Figure 3: Effect of Different Types of Noise Attack

CONCLUSIONS

In our paper we have proposed method for 3 dimensional medical image data. We have applies discrete weblet transform and discrete fourier transform. These two transform checks in all the three dimensions of the medical data and possibility of embedding without ant distortion in the core information of the data. DWT is used because of different slices of the data when processed it act like non stationary data. Since DWT work well for non stationary model therefore it is applied first after applying DWT we apply DFT to strengthen the method. We embed all the information obtained from the coefficients of these two transforms in each possible slice. At the receiver end where extraction is done all the above process would be applied in reverse order to get the original image and watermark information. The output PSNR value

indicates that there is no variation in the output signal and this proves the validity of the method.

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